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Most Popular All-Wave Receivers

1

THE "MEGADYNE" ONE-TUBE LOUDSPEAKER SET

By Hugo Gernsback

IN this article, the author describes the first practical one-tube loudspeaker set using a pentode tube. The set has been tested experimentally in a number of locations in the metropolitan New York district by several independent experimenters. In all instances, its performance was astonishing; not only did it bring in all locals on the loudspeaker with sufficient volume to

fill a large room comfortably, but distant stations as well.

Such stations as KDKA Pittsburgh, WTAM Cleveland, WBZ Springfield, WTAC Hartford, Conn., and many others were received with fair loudspeaker strength.

Experimenters and fans who have looked forward to a REAL one tube set now have their wish fulfilled.

THE advent of the new and more efficient tubes has made it possible to build radio sets which were not dreamed of five years ago. I have often stated editorially, that the radio art is headed in a direction where in the near future, it will be possible to obtain as much volume from a single one-tube set as we formerly obtained with a seven or ten-tube set.

Development of the Megadyne

Some time ago, I started to experiment with the idea of producing a one-tube loudspeaker set that would actually work and could not be classed as "tricky." I thought that the efficiency of the new screen-grid and pentode tubes would make this possible. A few of them were tried in all sorts of circuits, but it was found that no matter how good the usual circuit arrangements were, the volume that could be obtained from a loud-

speaker was not sufficient to call it loudspeaker volume.

I then resurrected my old *Interflex* idea, a circuit that I devised in 1925. This circuit was exceedingly popular at the time and several hundred thousand receivers using this circuit were built all over the world. To those who have forgotten the circuit, and to those

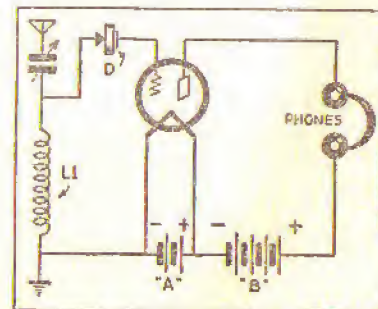


Fig. 1.—Showing "Interflex" Circuit.

who were not in radio at the time. I outline the circuit herewith in its fundamentals:

Figure 1 shows how the crystal detector is connected directly into the grid of a tube. The circuit is not of the reflex type, nor is there regeneration in any form. The crystal in the grid circuit acts as the *detector*, while the vacuum tube acts as an *amplifier*. The amplification obtained, depending upon the sensitivity of the crystal, is from 10 to 20, and may be greater in some cases. In other words, by using a crystal detector, the addi-

tion of the tube will give real amplification. The circuit is remarkable in that there is no distortion and the reception of the signal is clearer than when the tube is used alone; it being well known by radio engineers that the present vacuum tubes are poor detectors, whereas, due to the perfect rectification possible, there is nothing better than a crystal detector for clarity.

The Interflex system is made use of in the Megadyne (*megas*, the Greek for great; *dyne* from the Greek for power) and the results

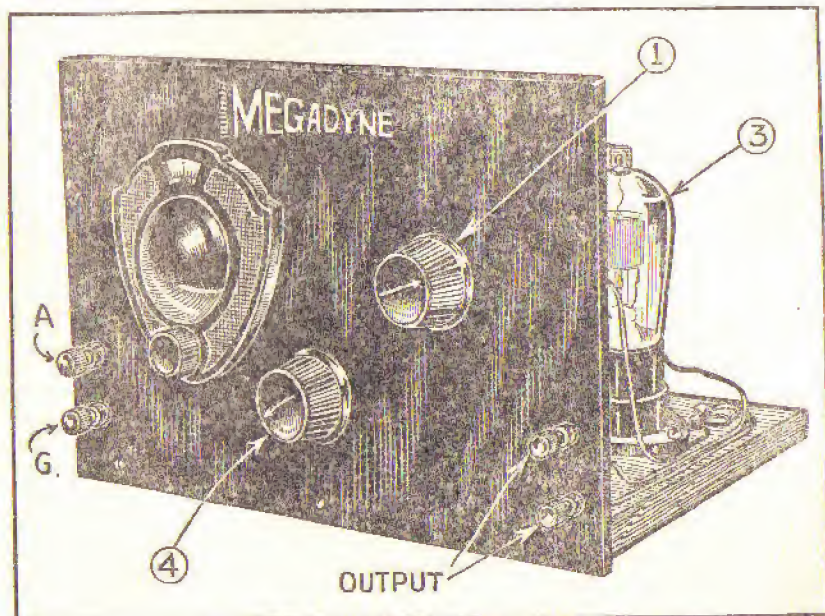


Fig. A.—Front View of 1-Tube "Megadyne."

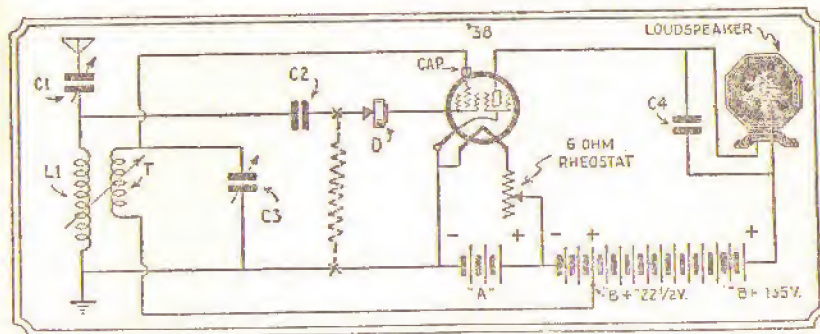


Fig. 2.—Schematic Diagram of the "Megadyne."

are astonishing. The final circuit of the one-tube loudspeaker set is illustrated in Fig. 2. It will be seen immediately that an entirely new circuit is used and, as a matter of fact, it will be noted that the tube works "backwards." The positions of the screen-grid and the control-grid have been reversed; the writer found that in practice this combination gave far greater amplification than the straight circuit. The reason for this is probably to be found in the better utilization of the space charge.

When building the Megadyne set, be sure to follow the circuit exactly, and for best results use the parts specified. Fig. A and B clearly show the layout of the components on the panel and base board.

Referring again to the circuit, we first have condenser C1, which is used to tune the antenna. Its capacity is .00032-mf. C2 is a small molded bypass condenser. .00025-mf. It is a new addition to the *Interflex* idea, and is quite necessary in this circuit. It will be

found that the circuit does not operate well without the condenser at this point. Remember that all connections between C1 and the control grid of the tube should be just as short as possible. They cannot be too short.

As to the crystal detector, in the *Interflex* circuit, I recommended the use of a Carborundum detector. It is still perhaps the best detector for this purpose, but unfortunately it is no longer manufactured. I therefore substituted a fixed crystal detector which is of the iron-type variety and which works very well in this particular circuit. I do not recommend a galena detector as it is not stable enough. Next to carborundum, iron pyrites is the best.

Note that, in this circuit, the crystal detector works best in only one direction. Try reversing its connections, and you will quickly find out which is best. It is not possible to do this on locals as the circuit will be found to work even without the crystal for strong

locals. It is only on distant stations when the necessity and superiority of the crystal detector becomes apparent. When trying to ascertain which is the best position for the crystal, tune in a DX or weak station and then find out which way it works best.

Regarding the tube, the circuit will be found to work well with such tubes as the 222, 224, 247, 232 and 233. I found, however, that the best results are obtained with a 228 tube.

Condenser C4 may be .00025-mf. to .0005-mf. The best one is ascertained by experiment. Condenser C3 is of the variable compression type, obtainable on the market, the value being from .0003-mf to .001-mf. *This condenser, while adjustable, is not used as a variable, and once adjusted remains in that position.*

As to the loudspeaker, remember, we have not any too much volume, and for that reason only a good magnetic loudspeaker will perform well. I have used successfully the better magnetic types which are available now.

Regarding batteries, the '38 tube uses 6.3 volts; the current consumption is low, i.e., .3-ampere. You can either use a 6-volt storage battery, or otherwise five new dry cells.

"B" Voltage: I recommend the use of 135 volts, though the set will be found to work well with only 90 volts.

The novelty of operation lies in the fact that the so-called screen-

Most Popular All-Wave Receiver

grid voltage connects to the control-grid—the cap of the tube.

And here is where some caution is necessary. If you use 135 volts, take a tap of 22½ volts *figured from the negative end of the "B" battery*. This tap goes to one side of the tickler as shown.

The three circuit tuner as used in this circuit may be any good type as long as it follows specifications. The secondary, wound on a bakelite or ordinary cardboard tube 2½ inches high. The tube is wound full 1½ inches with No. 30 D.C.C. wire. There are 68 turns all together. The tickler measures 1½ inches in diameter and about 1¼ inches wide. It is wound with the same size and kind of wire as the secondary, and there are 32 turns all together. The three circuit tuner specified has the usual primary. In this set it is not used and no connections are made to it.

Additional Notes

CAUTION. The tap on the "B" battery should not be more than 22½ volts, counting from the — B side. Considerably louder signals may be obtained by increasing this voltage to 45½ volts, *and here is where you have to be careful*. Certain types of tubes if used with a voltage higher than 22½ will "cherry" the grid, that is—due to the extra current flowing—the grid becomes overtaxed. If you find that the grid gets red hot, disconnect the excess voltage immediately and go back to 22½ volts, as other-

Most Popular All-Wave Receivers

wise you will damage the tube; but this does not apply to all tubes. Certain tubes as, for instance RCA, 38 are not affected in this manner, and they will take as high as 67½ volts on the control grid without cherrying. Therefore, always be sure to watch the grid and see that it is not over-

loaded. I may add that I have not found any tubes that give better results (louder signals) when a voltage higher than 45 is used on the control grid.

Condenser C3 is important because it adds to the volume of the

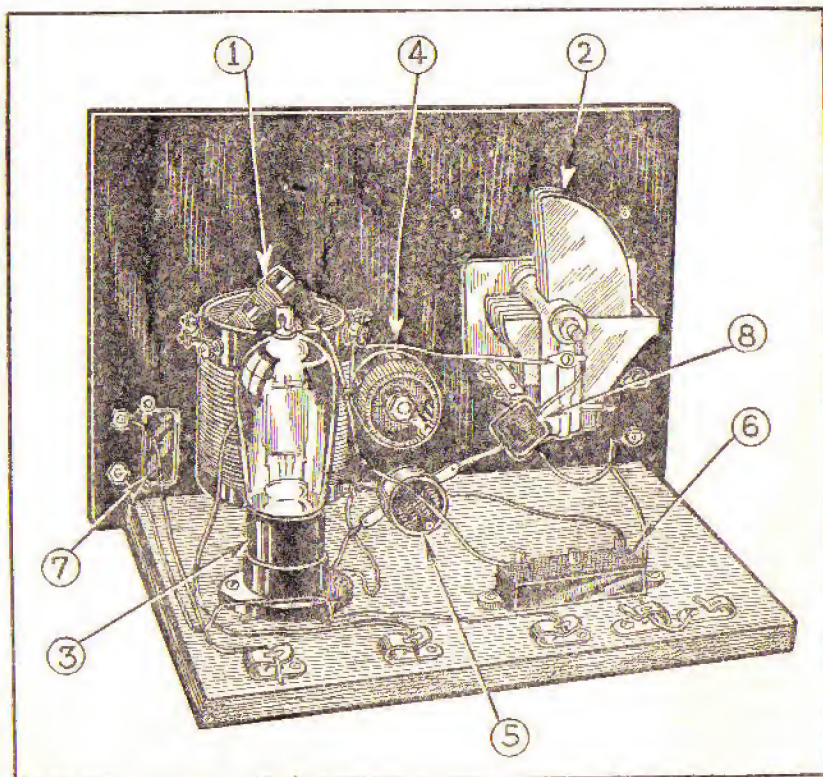
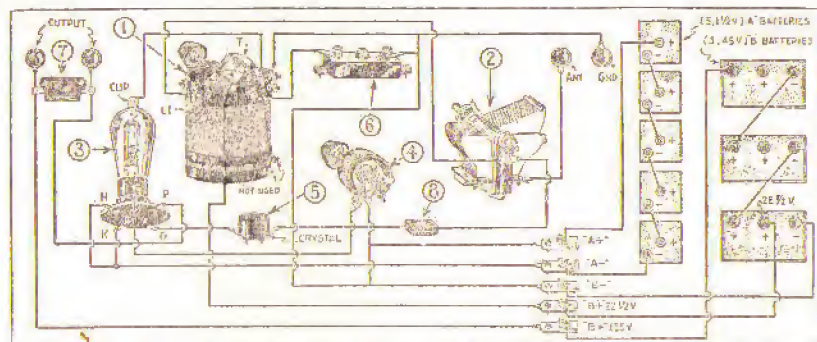


Fig. B.—Rear View Showing Placement of Parts.



Complete Pictorial Layout and Electrical Connections for the "Megadyne." Designating numbers correspond with those on Fig. 6.

signal. It is critical and should be adjusted to the lower waveband (higher frequencies). Select a station between 200 and 250 meters. The signal should not be too loud. Then with a screwdriver, which should be insulated, begin *slowly* to adjust the adjustable condenser. You will find that adjusting this condenser also affects the tuning somewhat. It will, therefore, also be necessary to adjust the tuning condenser C1 slightly until you reach a point in your adjustment of C3 where the signal comes in loudest. Some tubes have a tendency to "motorboat"—a sort of clucking, puttering noise is heard in the loud speaker: condenser C3 corrects this condition to a great extent. When the best adjustment has been found for the lower waveband, leave the condenser and do not touch it thereafter. Do not use too much regeneration because you will then get distortion although the signal will be louder. Best results will be obtained when the set

oscillates slightly, or just below the oscillating (whistling) point.

If, in rare instances, you find you cannot get the set to oscillate, try increasing the capacity of condenser C4. A larger condenser here sometimes helps. If the set still refuses to oscillate, it will then be necessary to use a higher voltage on the control grid. Try 45 volts with a series resistance so as to keep the grid from getting red.

Sometimes reversing the polarity of the tube heater or tickler leads helps.

If the set tends to "choke up," indicating that the signal grid is "blocking" it may be necessary to shunt 25 to 7 megohm gridleak across the signal grid (screen-grid of the tube) and cathode. This is indicated on the schematic diagram at the points marked "X." It might be well to use a variable gridleak.

Outside of this, the set will probably not be found to be tricky.

Of course, the set may also be used with headphones substituted

for the loudspeaker, and in this manner it will be able to get more stations because naturally stations several thousand miles away are not received on the loudspeaker except under unusual conditions. The set is really remarkable for DX work.

One word as to aerial and ground. The specifications given here presuppose an aerial about 125 feet long including lead-in. On shorter or longer aeriels, changes should be made in the secondary winding of the coil, although it may be corrected to some extent by using a small series condenser in series with the antenna or ground.

List of Parts

One tuner (for .00032-mf. tuning condenser);
One Hammett 320 mmf. variable condenser;

One Type '38 pentode tube;
One Carter 6-ohm rheostat;
One BMS fixed crystal detector;
One Padder Condenser, .0003- to .001-mf.;
One .00025- (or, .0005-) mf., mica fixed condenser;
One Aerovox .00025-mf. fixed condenser;
One 5-prong tube socket;
Four Eby binding posts;
Five Fahnestock clips;
One roll hookup wire;
Two Kurz-Kasch, 1 1/2 in. knobs;
One Kurz-Kasch vernier dial (scale 0-100, reading clockwise);
One bakelite panel, size 7 x 10 x 3/16-in.;
One baseboard, 5-ply size 7 x 10 x 1/2-in.

Note: Parts of different manufacture may be used, *but* their electrical specifications must be the same as those specified above.

ELECTRIFYING THE MEGADYNE FOR 110 VOLTS A. C. or D. C.

By Hugo Gernsback

IN the preceeding article in this book was described a battery-model "Megadyne," the loudspeaker set that requires only one tube—a pentode, and a crystal. In the following description will be found all the details for operating this remarkable receiver from the house current, thus entirely eliminating batteries.

The only fundamental difference between the battery set and the electric set, is the use of a simple "B" eliminator. The original set was designed to use a "uni-potential cathode" type of tube, the '38, which possesses two outstanding advantages: First, the ragged filament may be operated with full efficiency under wide fluctuation in the filament voltage supply which may be either A.C. or D.C. See

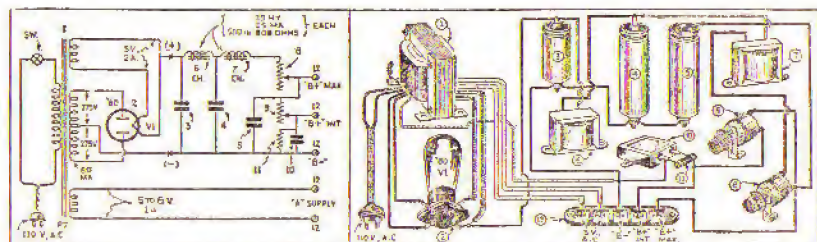


Fig. 2.—Schematic Diagram.

Fig. 1.—Pictorial Layout of Power Unit

ond: the thermal lag of the heater, and the uni-potential characteristic of the cathode, prevent the reproduction of hum when the filament is supplied with raw A.C.

This essential unit for electrifying the Megadyne, the "B" eliminator, is illustrated in Fig. A; Fig. 1 gives a pictorial diagram of connections and the schematic circuit is shown in Fig. 2.

Although this unit has been built up in "breadboard" style, for convenience in illustrating, the experienced constructor will have no difficulty in making a more compact agreement. Inexperienced constructors are cautioned to observe a few fundamental rules, should they desire to revamp the parts layout to suit a particular condition.

An important point, and the one to which particular attention must be paid, is the adjustment of variable resistor 9 which controls the voltage at terminal B-PLUS INT.—the potential for the control-grid (cap lead) of the '38. If this potential is permitted to exceed a certain critical value the grid will be seen, in a darkened room, to glow cherry-red, and continued applica-

tion of this voltage, which is considerably beyond the setting for best operation, will result in the destruction of the pentode.

A full-wave type 80 rectifier tube is employed for smooth D.C. output; the power transformer must be designed to deliver secondary potentials of 5 to 6 volts for the filament of the '38 pentode; 5 volts for the filament of the 80 rectifier tube and 275 volts on each side of the center tap of the secondary.

Residents of D.C. districts may be interested to note that by breaking the leads of this power unit at X, to eliminate the power transformer and rectifier, and connecting the two wires to the 110 V., D.C. power-line leads having the polarities indicated, (reversing the plug in the socket will check this condition), D.C. plate supply will then be available; the final step, to obtain filament current from a D.C. power circuit, is to connect the filament terminals to the light-line, with a 35- or 40-watt lamp in series. Fuses rated at 2 Amperes must be connected in both sides of the power line; a ground is not necessary, a .01-mf. fixed condenser should be connected in series

with the aerial of the receiver when used with the D.C. power pack. **Caution:** The electrolytic condensers should be of the unpolarized type if the pack is to be operated on D.C. or else the fuses will blow.

Due to the design of this power unit, it is possible, whether operated from 110 volts D.C. or A.C. to secure very flexible control of the output potentials, by adjustment of resistors 8 and 9. Electrolytic by-

pass condenser 5 is particularly effective as resistor 8, in addition to acting as a voltage-limiting unit, also functions as a part of the filter system.

In the "breadboard" model, a common "can" connection for the three electrolytic condensers is obtained by mounting them on a strip of aluminum about $\frac{3}{4} \times 5\frac{1}{2} \times \frac{3}{32}$ -in. thick, supported, $\frac{3}{4}$ -in. from the baseboard by means of two metal brackets. The new elec-

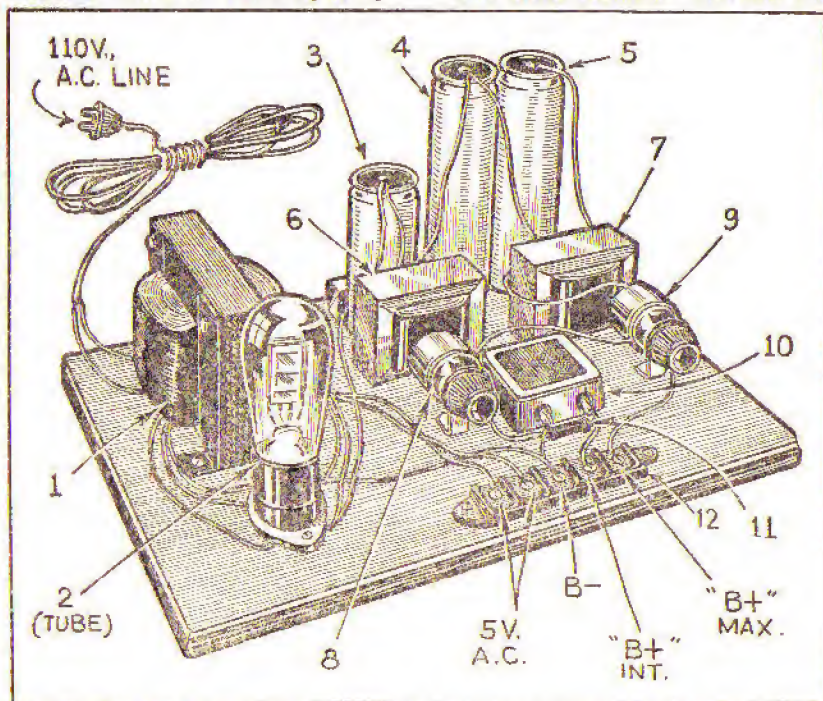


Fig. A.—Completely assembled Power Unit. Numbers correspond with Figs. 1 and 2.

trolytic condensers in cardboard containers may be used too, in place of those in cans, if so desired. Resistors, 8 and 9 are rheostats mounted on brackets.

Exceptional care has been taken in the design of this unit to reduce the hum level at the output potential terminals to the lowest possible point; however, the fields of the power transformer and the filter chokes are very strong, and if they are permitted to interact with the receiver equipment, hum from the reproducer will be heard. It is good policy to keep the power pack as far from the receiver as space permits—three feet at least.

Resistors 8 and 9 are adjusted so that stations come in loudest. The adjustments are then left in position and should not be touched thereafter.

Tuning and operating the Megadyne remains as before.

List of Parts

One power transformer, having one

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5 to 6-volt winding rated at 2 amperes or more; one 5-volt winding at 2 amperes; one center-tapped winding at 275 to 350 volts either side of the center tap;

Two filter chokes, each 30 henries, 25 ma., 500 to 800 ohms 6, 7;

One unpolarized electrolytic condenser, 4 mf., 400 volts, 3;

Two electrolytic condensers, 8 mf., 400 volts, 4, 5;

Two Clarostat variable rheostats, type CS, 0 to 5 megohm range, 20 watts 8, 9;

One 1—mf., 200-volt condenser, 10;

One fixed resistor, 10,000 ohms, 1 watt, 11;

One binding post strip, 12;

One tube socket, UX-type, for V1, 2;

One power cable, with plug;

One wood baseboard, 7½ x 11½ x ½-in.

A BEGINNERS' "ALL-ELECTRIC" 1-TUBE A. C.-D. C. SET

By F. R. Harris

THE first really one-tube ALL-ELECTRIC Set using VACUUM-TUBE rectification. Operates on any 110-volt line, any current and frequency. The Ideal Beginner Set.

A

REALLY "1 tube" set, which would operate from the regular power lines—110 V., A.C. or D.C.—has

long been the dream of experimenters but it has never, to date, been accomplished. There have been described, before this set, which were, technically, of the 1-tube variety, obtaining their power from copper-oxide rectifier stacks and similar expedients but the complication and expense of these methods greatly overbalanced the ad-

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vantages gained through the elimination of the separate rectifier tube. However there has recently been introduced a new tube, known as the type 12A7, which combines a power output pentode and a half-wave rectifier in the same glass envelope and—behold—we have our 1 tube electric set! The completed set is shown in Figs. A and B. The schematic circuit is Fig. 1.

The 12A7 Tube

The tube is the heart of this circuit—without it, the circuit would be impossible. Its characteristics combine those of two regular tubes. The glass envelope, of the standard size known as ST12, is the same size and shape as that used for type 58 and 77 tubes and others; it contains a pentode section practically identical with the type 38 tube, and in addition, a half-wave rectifier element. Each has its own cathode and its own separate base pins. The base is of the small 7 pin type and the control-grid of the pentode is connected to the tube cap. Base connections for the tube are given in Fig. 1.

Construction

As will be seen from the illustration, the set is laid out on an aluminum chassis. The complete layout of the two chassis pieces is given in Figs. 2 and 3. If other than the specified parts are used the layout will, of course, have to be changed accordingly.

The tuning condenser is mounted on the front panel through the medium of two No. 6-32 bolts. Several small washers or other form of spacer are placed over each

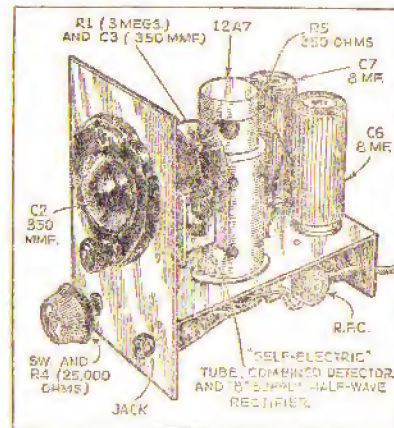


Fig. A.—Set Ready for Operation. screw between the panel and frame of the condenser to hold it parallel to the front panel.

The filament resistor, R5, is mounted upright through a single hole in the sub-panel by means of one of the screws that will be found holding the brackets. A cardboard tube is generally packed around the resistor on which is marked lines indicating one-eighth of the total resistance; if you do not have available a voltmeter to set the filament voltage across the tube to its proper value it can be arrived at approximately by setting one end sliding contact opposite the first of these marks. This filament resistor becomes quite hot in operation so do not fail to remove the cardboard tube and keep all insulated wires well clear of this resistance.

In mounting the jack for the phone plug be sure that the frame

and lock nut are well insulated from the chassis. Otherwise you will have a direct short across the power supply which will probably ruin the rectifier section of the 12A7 tube. Also be sure that the center arm of the potentiometer R4 is not grounded to the chassis or it will be impossible to control oscillation.

When you are absolutely sure that all wiring is correct, you may insert the line plug and turn on the switch. After a few seconds a bright point of light will be seen inside the cathodes of the tube and they will gradually heat up to a dull red glow. The circuit is then ready to operate. If D.C. is being used, it may be necessary to reverse the plug.

Warning: The post marked "Gnd" on the diagram is not to be con-

nected to a ground unless it is absolutely necessary to do so to secure quiet operation and then only after a 0.5 mf. paper condenser has been inserted between the ground wire and the "Gnd" post on the set. Do not permit the ground wire to touch the metal chassis.

Attach the antenna, and plug in the headphones. Screw the adjusting screw on C1 almost all the way in and turn R4 all the way to the right. Now, on turning the tuning dial from one end to the other a series of squeals should be heard. If this does not occur it indicates that the circuit is not oscillating. Turn back the screw on C1 slightly and try again. Keep trying this until oscillation occurs all over the dial with C1 screwed in as tightly as possible.

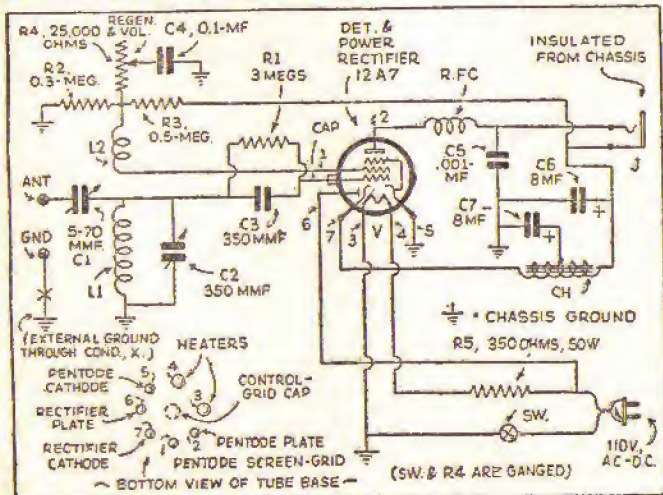


Fig. 1.—

Complete schematic diagram of the 1-Tube All-Electric Set. When using an external ground be sure to use a series condenser at the point in the diagram marked with an "X."

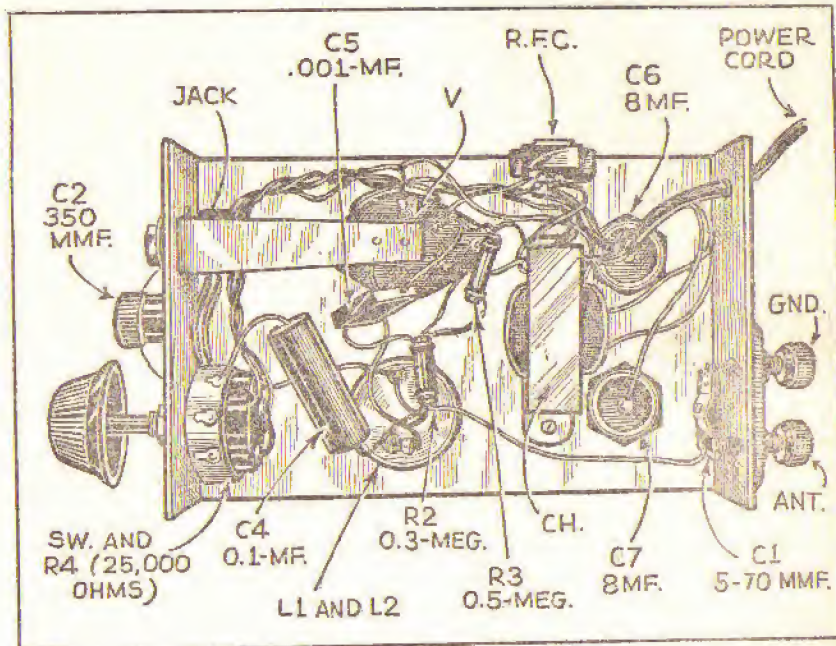


Fig. B.—Underside View Showing Layout of Parts.

The position of C1 will depend greatly on the aerial used, the longer the aerial the looser C1 will probably have to be since a long aerial loads the circuit and keeps it from oscillation. However, a long aerial is necessary for proper pickup and for any DX work. About 75 feet, as high as possible and well insulated would be about right.

Once the proper position for C1 is found it may be left alone and the only controls necessary will be the tuning dial and R4 for feed

back. Like any oscillating circuit the most sensitive point will be found just outside the zone of oscillation. Slow, careful tuning and skillful handling of the oscillation will result in some rather remarkable DX records for such a simple set.

Theory

There is nothing remarkably new in any single feature of the set, the novelty results from the combination of features in a single unit. The signal, picked up by the antenna is fed through C1 to the

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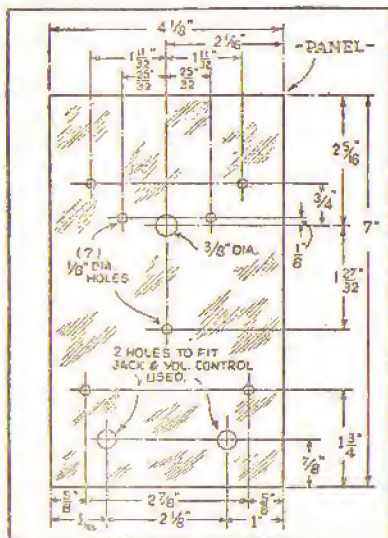


Fig. 2.—Front Panel Layout.

tuned circuit C2-L1 and thence through the grid leak and condenser to the grid of the tube where detection takes place. The audio component of the signal is fed from the plate to the tube through the headphones while the radio frequency component of the signal is blocked by the choke L3 and forced to travel through L2-R4 and back to ground through C4. The strength of the radio frequency current in this circuit, and hence the amount of feed back is governed by the resistor R4.

Power is supplied to the plate of the tube through the rectifier portion of the tube which gives rise to a pulsating D.C. This is filtered

into a pure D.C. by the network L4-C6-C7. No condenser is put on the rectifier side of the inductance CH. for two reasons. First, a high value of D.C. voltage is not desirable for grid leak detection; and a condenser input would raise this value considerably. Second, a choke, input, as used, tends to lessen the difference between the plate voltage when used on A.C. and D.C. lines.

The resistor R5 serves to drop the line voltage of 120 to the 12.6 required by the filament of the tube. This had better be adjusted

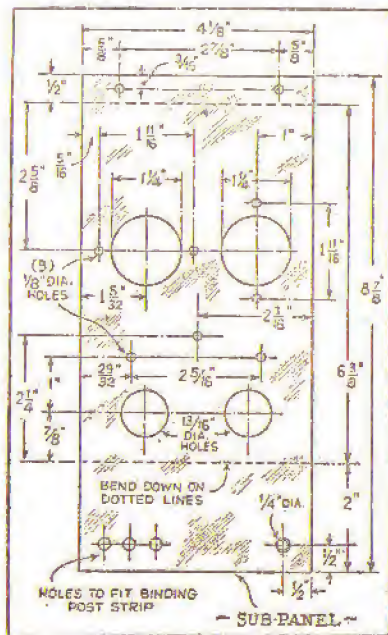


Fig. 3.—Sub-Panel Layout.

by means of a voltmeter to the proper value if possible.

Troubles

No Oscillation:

Reverse connections to L2.

Be sure condenser C4 is non-inductive type.

Be sure choke RFC is effective.

Raise screen-grid voltage by decreasing value of R3.

As a last resort increase turns of
L2.

Be sure R4 is connected in the right direction: so that when the line switch is off the resistance is all in.

Uncontrollable Oscillation:

Decrease screen voltage by increasing value of R3.

Decrease value of C4.

Remove choke RFC, if this completely stops oscillation decrease value of C5.

Check circuit for unwanted sources of feed-back.

As a last resort decrease turns on
12.

Fringa hawii on "Plop":

This is controlled largely by the value of R2; the smaller this value the more smoothly oscillation occurs down to the point where control through R4 is lost. The voltage on the screen-grid is rather critical in this circuit. If it is too low the circuit will not oscillate and will be less sensitive generally. If it is too high it may cause an annoying 60 cycle hum in the phones. The trick is to get it as high as possible without allowing this hum to occur or causing uncontrollable oscillation. This voltage is governed by the network R2, R3,

and considerable experimentation with these two values will probably be rewarded with greatly increased sensitivity and better all-around performance.

List of Parts

- One midget tuning condenser, 350 mmf., C3;
One Hammarlund trimmer condenser, 5-70 mmf. C1;
One pig-tail mica condenser, 350 mmf., C3;
One pig-tail mica condenser, .001 mf., 5C;
One paper condenser, .1-mf., C4;
Two electrolytic condensers, 8 mf., C6, C7;
One Centralab potentiometer with line switch attached, 25,000 ohms, R4;
One carbon resistor, $\frac{1}{2}$ -W., 3-meg., R2;
One carbon resistor, $\frac{1}{2}$ -W., .5-meg., R3;
One carbon resistor, $\frac{1}{2}$ -W., 3 megs., R1;
One wire-wound resistor, 350 ohms, 50 W., R5;
One R.F. coil, screen-grid interstage, shielded, L1, L2;
One 85 mhy. R.F. choke coil, R.F.C.;
One midget filter choke, 20 hy., center tapped, CH.;
One single-circuit jack and insulating bushing, J;
One small 7 prong wafer socket;
One type 12A7 tube;
One binding post strip marked "Ant.-Gnd.";
Aluminum for panels, 1/16-in. thick, wire, small hardware, line
- Note:* These parts may be of different manufacture but must have the specified electrical characteristics.

switch mounted as shown in Fig. A. Thus, not only does this feature facilitate a wider tuning frequency range, but should the constructor desire to use this set for regular broadcast reception (using a broadcast plug-in coil from which a few secondary turns are removed) he will find that the operation is much more highly efficient and satisfactory. This may be attributed, in engineering parlance, to an "improved L/C ratio."

Circuit Design

Referring to Fig. 1 it will be noted that the two tubes employed are the new "multi-purpose" types 6F7 and 12A7. The 6F7 tube really comprises two tubes in one glass envelope, a pentode and a triode. In this receiver the pentode section is employed as the regenerative detector, and the triode section as the first audio stage. Thus, two-tube efficiency is obtained from this single tube. The 12A7 also comprises two tubes in one glass envelope, but the type of operation and arrangement of the elements within the tube are entirely different. Here we find a power pentode (whose characteristics are identical with the 38 power tube) and a half-wave rectifier all in one unit. By utilizing the power pentode section of this tube as the final power audio stage, and the half-wave rectifier for rectifying the alternating current, when it is operated from A.C. (on D.C. the direct current continuously passes through the tube) we obtain two-tube efficiency from this single tube. The net total, as a result of this arrangement, is full four-tube efficiency from two tubes. No re-

Most Popular All-Wave Receiver

flexing or other tricks, just a straightforward regenerative detector followed by two stages of resistance-coupled audio amplification, the final stage being a power audio, and a rectifier or "B" supply—all from two tubes.

The heaters of these two tubes are wired in series, thus requiring a filament voltage of 18 V. and a current of 0.6 of an ampere (or 600 ma.). This is obtained from the power line by means of a series resistor (325 ohms), or a power cord in which this value of resistance is included. No power transformer, or any other transformer whatsoever, is employed. The 110 V. supply—A.C. or D.C.—is fed directly to the half-wave rectifier section of the 12A7 tube. The efficiency of this rectifier is such that the voltage drop through it may be considered as being almost negligible. Since resistance coupling is used in the audio stages, no audio transformers are necessary.

Two low-resistance power chokes (only 100 ohms resistance, approx., each) are employed in the filter section. This design, coupled to the use of three electrolytic condensers, completes the filtering arrangement, as shown in Fig. 1, and has been found more than sufficient to remove any trace of ripple or hum.

Regeneration is obtained by inductive coupling of the "plate" winding to the secondary or "grid" winding. It is controlled, however, by a midget 140 mmf. variable condenser (mounted under the sub-base, as shown in Fig. A which regulates the amount of R.F. energy existing in the plate circuit.

Most Popular All-Wave Receivers

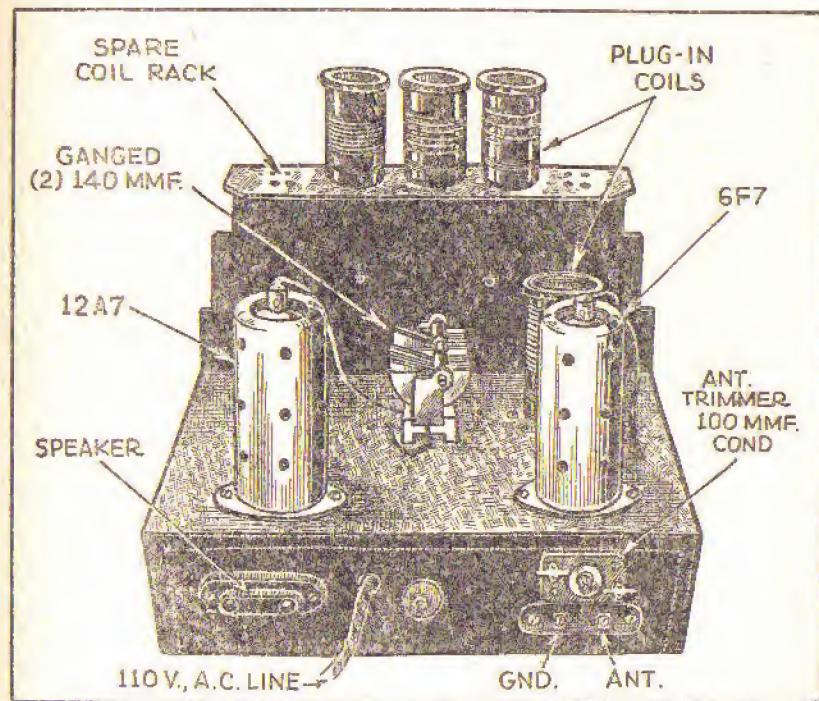


Fig. B.—Rear View Showing Layout of Main Parts.

Regeneration may also be controlled by the volume control which is shunted across the plate coil and thus serves as a controlled short-circuiting device to regulate volume or regeneration. For broadcast reception this control will be found considerably more effective for regeneration regulation. It is recommended that the single variable condenser be used on short-waves for this pur-

pose, and left at maximum capacity for the broadcast band in which case the volume control is used in its stead.

List of Parts

One Hammarlund tandem, dual-section, 140 mmf. (each) variable condenser gang;

One complete set of plug-in coils (5, with broadcast coil, 4 only for complete short-wave coverage);

One single Hammarlund midget

variable condenser, 140 mmf.;

Two General Transformer chokes, 80 hy., 100 ohms each;

One Hammerlund R.F. choke, 85 mhy.;

Two Cornell-Dubilier electrolytic condensers, 16 mf., 200 V.;

One Cornell-Dubilier electrolytic condenser, 8 mf., 220 V.;

Two 7 prong wafer sockets (small) for 12A7 and 6F7 tubes;

One 4 prong wafer socket for plug-in coils;

One I.R.C. resistor, 1,500 ohms, 1 W.;

One I.R.C. resistor, .1-meg., 1 W.;

Two I.R.C. resistors, .25-meg., 1 W.;

One I.R.C. resistor, .5-meg., 1 W.;

One I.R.C. resistor, 750 ohms, 1 W.;

One I.R.C. resistor, 2 meg., 1 W.;

One wire-wound resistor, 325 ohms, 40 W. size, or power cord with equivalent resistor built-in;

Two S.P.S.T. toggle switches;

One volume control, 50,000 ohms;

Two Cornell-Dubilier tubular con-

densers, .1-mf., 400 V.;

Two Cornell-Dubilier tubular condensers, .006 mf., 400 V.;

One Cornell-Dubilier mica condenser, .001-mf.;

One Cornell-Dubilier electrolytic condenser, 10 mf., 50 V.;

One antenna trimmer condenser;

One drilled sub-base and panel unit (as shown in illustrations);

One type 12A7 tube;

One type 6F7 tube;

Miscellaneous supplies, such as wire, hardware, vernier dial, etc.

Note: These parts may be of different manufacture but must have the same electrical specifications.

Conclusion

This receiver, if wired carefully and as per Fig. 1, should operate to the complete satisfaction of any constructor. The adjustment of the antenna trimmer condenser may be rather critical if an antenna system of relatively long dimensions is employed. For best results use a short overhead wire (about 35 ft.) placed as high as possible.

SUPER-REGENERATIVE SINGLE-TUBE LOUDSPEAKER SET

By W. P. Chesney

YEARS ago, when radio was being developed by the experimenter and the amateur, a one tube loudspeaker set was the ultimate goal of every constructor. Various types of circuit combinations and forms of receivers were tried and built, and in a good many cases actual loudspeaker results with one tube were

obtained. In favor of other fads or fancies, interest in developing maximum efficiency from a single tube waned. The constructor became caught in a maelstrom of other intriguing possibilities of radio which took his attention away from this most interesting and worthwhile work. But now, with interest being resumed in

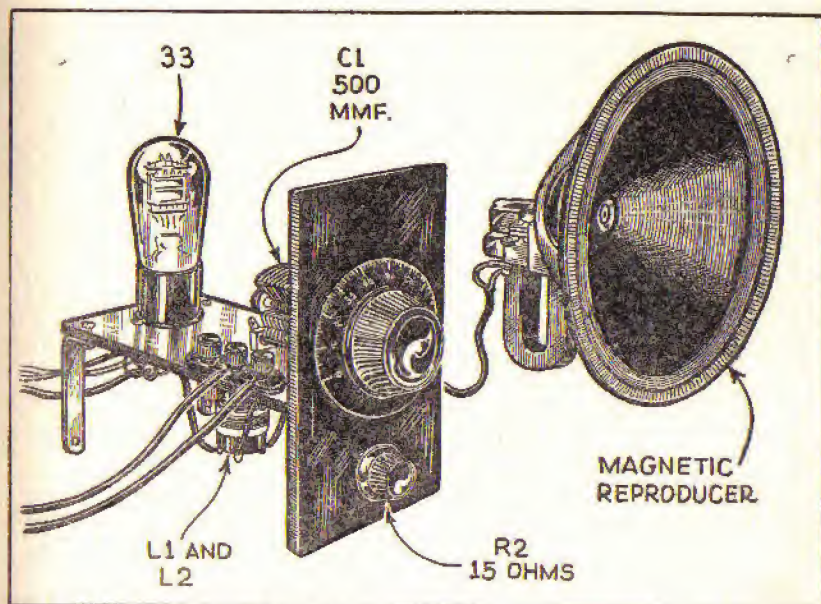


Fig. A.—Front View of Set. Note small size compared to speaker.

small receivers, as evidenced by the increasing popularity of the midget set, and since more highly developed tubes—(from an angle of sensitivity and power output) are available—the constructor and experimenter is once more focusing his attention in this direction.

To the uninitiated, it is not desired to convey the impression that it is possible to construct a one tube set that will duplicate the efficiency of a five or six tube set. What is emphasized is that no machine or electrical device is anywhere near 100 per cent efficient. Particularly is this true in the case

of a vacuum tube. And since there is room for improvement in this case, through careful study of the problems involved and careful construction of the receiver, it is more than possible to make one tube operate a loudspeaker (with fair sensitivity) to the satisfaction of the user.

Since only one tube is employed, its function is limited to that of detection, or rectification as some term it, essentially because the high-frequency signals fed to the tube by the tuning coil and condenser arrangement must be converted to D.C. (of a pulsating nature) so as

to operate the loudspeaker. Some means of boosting the strength of the signal must be provided for, since no further stages of amplification are permissible. In earlier models of one tube loudspeaker sets, regeneration in various forms was employed for increasing the output from the tube. Because regeneration returns any excess A.F. energy that exists in the plate (or output circuit) of the tube back to the grid or input side to be amplified and rectified, we can readily see why this form of circuit minimizes any dissipation of energy and therefore increases the efficiency obtained from the tube.

The parts can be found in any radio shop for a very small sum and with the exception of the batteries and tube the cost usually runs less than \$6.00 including a low-priced speaker. The total cost for the complete outfit only runs around \$10.00. For the man who has no electrical supply in his home and wishes a battery radio set that will work well with a speaker and, above all, the cost of material not to exceed \$10.00. I believe this

simple set will prove most interesting. The first cost is low and the upkeep is far below the average radio receiver.

To obtain even more amplification and real loudspeaker results, the circuit employed in this one tube set is of the "super-regenerative" type. But, lest the reader be frightened by what he has heard about so-called "supers," let me emphasize that this set is not the least bit critical, unstable, or in any way temperamental in its operation. Upon careful consideration of the schematic wiring circuit, shown in Fig. 1, it is noted that it is in reality a "Flewelling" super, one of the most stable and easily built super-regenerative receivers that has as yet been devised. The receiver is built around a 33 tube which is a power pentode that requires only 2 V. of "A" battery for filament supply, and either 90 or 135 V. of "B" batteries. The latter voltage, when used, will give slightly more volume, but average results may be obtained from 90 V.

With the exception of the coil, which has two windings, all other

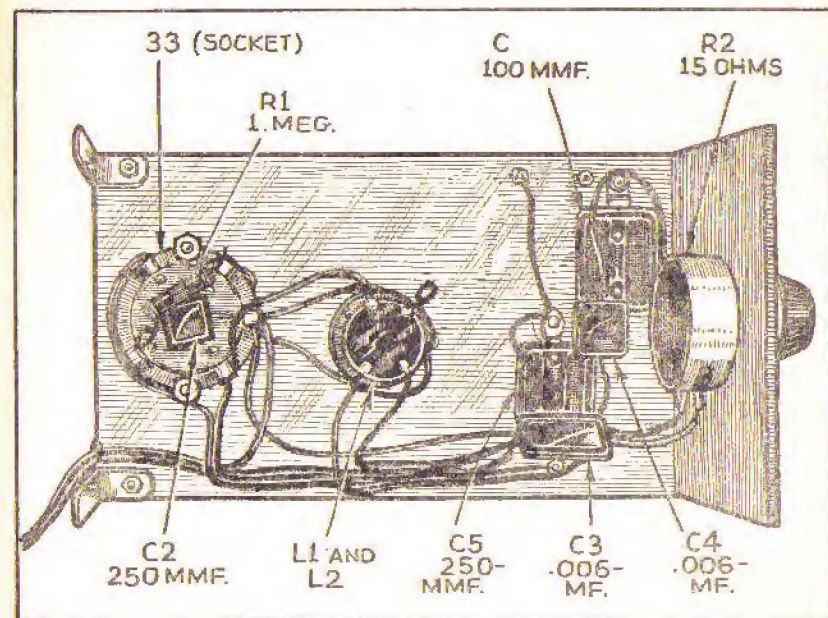


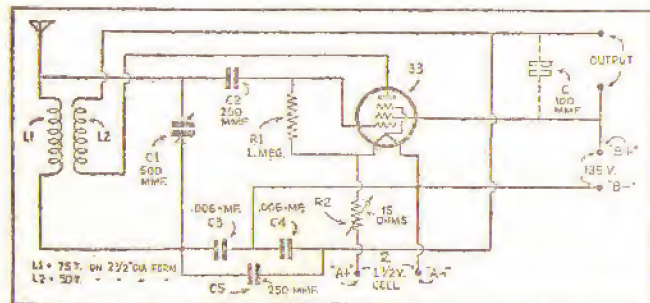
Fig. B.—Underside View Showing Placement of Parts.

material can readily be obtained. The coil must be especially made by the constructor, and is wound on a 1 in. diameter form, about 3 ins. long. The secondary, L1, consists of 110 turns of No. 32 enamel covered wire. The primary L2, or plate coil winding consists of 45 turns of No. 36 D.S.C. wire wound below the grounded end of the secondary. The suggested layout and construction are shown in Figs. A and B.

Adjustment and Tuning

If the set seems to be insensitive then the trouble is possibly

due to the connections to the coil winding L-2 being reversed. This winding must be in proper phase relationship to L1 or else regeneration will not take place. Fixed condensers, C3, C4, and C5, must be exactly as specified and mica-dielectric type is recommended to reduce the losses and inconsistencies that occur in the paper type. It is through these condensers that the superregenerative action is obtained. A 100 mmf. fixed condenser may be connected across the output terminals, but will not be necessary in all cases. Its inclusion will be



Schematic Circuit of 1-Tube Loudspeaker Set. Connect ground wire to lower end of L-1.

necessary if a persistent whistle takes place—but in some cases will also help to actually increase the volume. R2 controls the volume and stability of the receiver, by regulating the filament temperature of the tube. Stations are obtained by simply tuning the variable condenser, C1.

To obtain good loudspeaker volume, a high impedance magnetic type loudspeaker is recommended. It should preferably be of a "close" gap construction, which feature makes the unit highly sensitive, though it might tend to chatter a little on extreme volume.

Too large an antenna for this receiver should not be used. It may dampen the sensitivity of the set instead of increasing its efficiency. An approximate total length of 75

Most Popular All-Wave Receivers

feet will be found to be ideal.

In Fig. 1 are given optional coil winding data.

A ground is not always necessary; it should be tried, though. Connect it to the end of L1 opposite the antenna connection (or, the junction of L1, C1, C3 and C5).

List of Parts

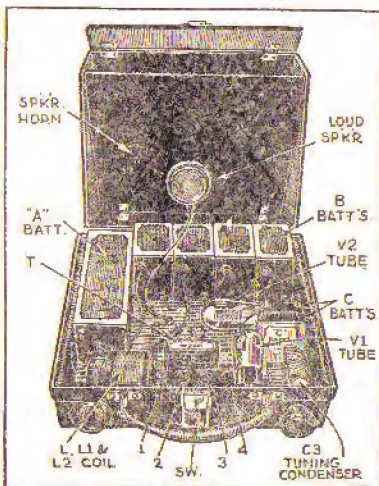
One 500 mmf. variable condenser, C1;
One mica fixed condenser, 250 mmf., C2;
Two mica fixed condensers, .006-mf., C3, C4;
One fixed condenser, 250 mmf., C5;
One resistor, 1 meg., R1;
One 15 ohm rheostat, R2;
Miscellaneous parts, such as 5 prong socket, hardware, chassis base, binding posts, 33 tube, and magnetic type loudspeaker.

PORTABLE TWO-TUBE BATTERY LOUDSPEAKER RECEIVER

WHILE formerly several tubes requiring heavy batteries of large capacity were employed in portables to obtain loudspeaker volume, now the pentode with its loud-speaker output can be used alone with a minimum of battery space and weight.

In the set illustrated, only two

Fig.B.—Right, showing the complete portable set.



Most Popular All-Wave Receivers

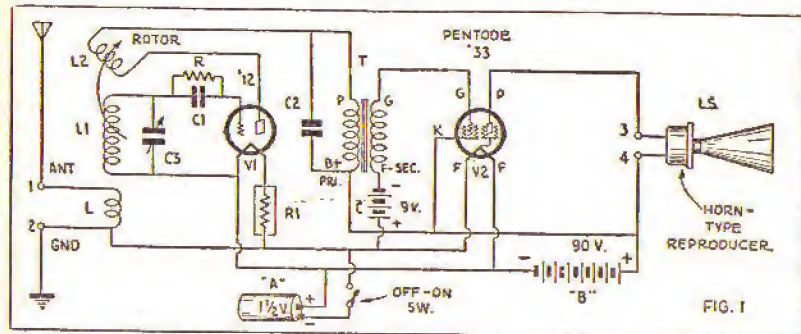


Fig. 1.—Schematic Diagram of the Battery Portable Receiver.

tubes are employed; a type WX-12 ("general purpose") and a type '33 audio pentode. The reason for this particular combination will be pointed out later. The carrying case is that belonging to a small portable typewriter; but any suitable box may be employed, or one can be made especially for the purpose. The folding loud speaker is built into the cover. One dry cell supplies the filament voltage; while four of the smallest sized 22½-volt "B" batteries provide the plate potential.

The circuit is a simple regenerative one, employing one of the small three-circuit tuners so popular a few years ago. While the tone quality is not comparable with that of the modern receiver, with dynamic reproducer and power amplifier, it is equal to that obtained from a small portable phonograph; and on locals, and for distances up to a thousand miles, the volume is loud enough for filling a large room.

The WX-12 tube was selected, not

only because it is a good detector, but also because its required filament potential (1.1 volts, requiring only one "A" cell) fits in with the design of the set.

Fig. 1 shows the final schematic circuit. The three-circuit tuner (comprising the primary, secondary and tickler coils L, L1, L2, respectively) has the secondary L1 tuned by the .00035-mf. midget variable condenser C3; this covers the broadcast band. The grid condenser C1 has a capacity of .00025-mf. and is shunted by the grid leak R of 2 megohms. R1 is a fixed filament resistor of 1.5 ohms. An Amperite or filament rheostat may be used, or a fixed resistor may be used, or a fixed resistor with an adjustable contact.

The bypass condenser C2, which shunts the audio transformer T, has a capacity of .0005-mf. The "A," "B" and "C" voltages are indicated on the sketch. The loud-speaker unit L.S. is of the horn type and should have a low impedance, in the order of 7500 ohms;

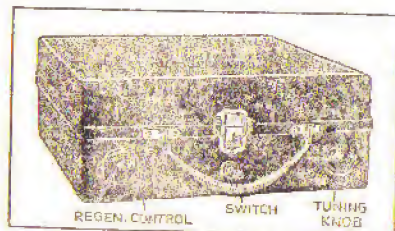


Fig. A.—Closed View of Portable.

although any good horn unit may be used.

The illustrations Figs. A and B and Fig. 2, show the general layout. The parts are mounted directly on the case; with the tickler and tuning condenser knobs, and the filament switch, on the handle side, or top (when closed, as shown). The batteries and dry cell are securely fastened to the bottom of the case by means of a thin strip of brass bent around them and secured at each end to the case with small wood screws. The four binding posts, for aerial, ground, and loud speaker, are mounted on a bakelite strip $3/16$ by $5/8$ by $1/4$ in. which is attached to the case with two angle brackets. The tube sockets are mounted on the sides of the case as shown.

Novel Loud Speaker

The loud speaker used in this set is somewhat novel. While not of the best design from an acoustical standpoint, it works very well and occupies little space. The horn structure is shown in Fig. 3. A piece of $1/4$ -inch plywood, which will fit snugly within the cover, is hinged to it as shown. Near the hinged side is bored a hole (X, Fig. C) to receive the throat of the

horn-type unit LS. When in use, the hinged portion swings out to the position shown, forming one side of the horn. When not in use, the unit is removed and placed in a metal clamp at the bottom of the case; the hinged portion is pushed in and the cover closed, as shown in Fig. B; making a compact outfit about $4\frac{1}{2}$ in. by 10 in. by 12 in. overall and weighing less than 12 pounds!

For the ground connection, it is necessary to provide a wire lead which, by means of a spring clip on the free end, may be attached to any large metal object or network, such as grounded pipes or a metallic framework.

To tune in, turn the tickler knob so that the circuit oscillates, (manifested by a rushing "noise") and then turn the tuning dial until a heterodyne squeal of the station is heard. Then slowly turn the tickler back changing the tuning slightly (if necessary) with the other hand, until the station is clear.

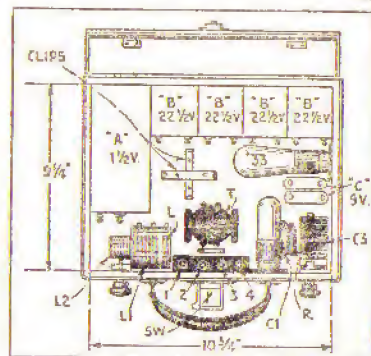


Fig. 2.—Layout of All Parts.

List of Parts

- One "Corona" typewriter carrying case, $10\frac{3}{4}$ x $9\frac{1}{4}$ x 4 inches deep (inside dimensions);
- One Gen-Win 3-circuit tuner (L, L1, L2);
- One Hammett .00035-mf. mid-gate variable condenser (C3);
- One Polymet .00025-mf. grid condenser (C1);
- One Polymet .0005-mf. bypass condenser (C2);
- One 2-meg. grid leak (R);
- One Carter 1.5-ohm resistor (R1);
- One "replacement"-type A.F. transformer (T);
- Two Burgess 3-cell flashlight batteries ("C");
- One Burgess 1.5-volt dry cell ("A");
- Four Burgess 22 $\frac{1}{2}$ -volt batteries ("B");
- One 4 prong socket (for V1);
- One 5 prong socket (for V2);

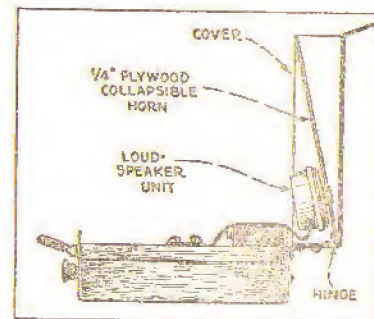


Fig. 3.—Speaker Details.

- One type WX-12 tube, 1.1-volt filament (V1);
- One type '33 pentode tube (V2);
- Four binding posts, with bakelite strip and brackets (1, 2, 3, 4);
- One filament switch (SW);
- Miscellaneous screws, wire, soldering lugs, etc.

BEGINNERS' ONE-TUBE ALL-WAVE BATTERY SET

By F. R. Harris

BROADCAST wavelengths and the programs they carry are very interesting, but the real thrill of radio lies in the short wavelengths — the higher frequencies — on which it is possible to pick up programs of all kinds from

the very ends of the earth! This receiver is designed to receive both!

Don't get the idea, though, that this means complication and difficulty.

The set we are building is the simplest and one of the best bread-board styles. It is designed for the

absolute beginner who is neither radio man nor mechanic, and yet it will equal or better the perform-

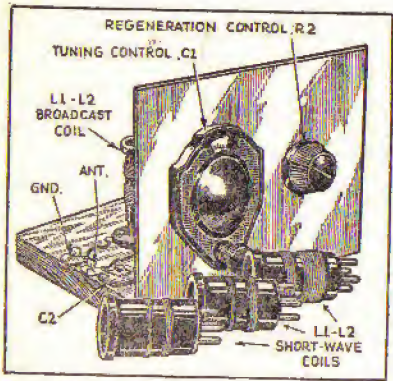


Fig. 8.—Front View of Set.
ance of many more elaborate lay-
outs. Under actual tests it received
(with the broadcast coil) all local
stations with comfortable room vol-
ume on the loudspeaker.

While we are on the subject of
wave bands it might be well to give
a list of the principle divisions and
their allotted uses; the tabulation
gives the frequency in kilocycles
(kc.) and the equivalent approxi-
mate wavelength in meters.

Usage	Kc.	Meters
Regular		
Broadcast	550 to 1,500	545 to 200
Short-		
Wave	6,000 to 6,150	50 to 48.7
Broadcast	9,500 to 9,600	31.5 to 31.2
	9,500 to 9,600	31.5 to 31.2
	11,700 to 11,900	25.6 to 25.2
	15,100 to 15,350	19.8 to 19.6
	17,750 to 17,800	16.9 to 16.8
	21,450 to 21,550	14.0 to 13.9
	25,600 to 26,600	11.7 to 11.2
Police	1,555 to 1,712	193 to 175
	2,412 to 2,508	124 to 119
Aircraft	2,300 to 3,500	130 to 85.6

Amateur	1,800 to 2,000	166 to 150
Phone	3,900 to 4,000	76.8 to 74.9
	14,150 to 14,250	21.2 to 21.1
	28,000 to 28,500	10.7 to 10.5
	56,000 to 60,000	5.3 to 4.9

The set we are building is de-
signed to cover all of these bands
from 550 to 18,000 kc. (545 to 16
meters), which should be ample to
give a real introduction to the
world of short waves; after which
—unless we miss our guess—you
will be, "rarin to go," to build a
more elaborate layout with greater
range.

Construction

The first step in construction is
to get together *all* the material
specified in the List of Parts; the
necessary tools; and a fairly large,
firm table upon which to work.
Tool requirements are simple: a
medium- and a small-size screw-
driver; a pair of diagonal cutters;
a pair of thin, long-nose pliers and
a second pair of sturdier construc-
tion; a wood saw; a plane; a flat
file and a rat-tail file; a hand-drill
and a few drills (one No. 18 and
one 1/4-in. will be enough to start);
a soldering iron (preferably elec-
tric) and some resin core solder.
Of course, you can use many more
tools, if you have them, but those
mentioned above will be enough to
do the job.

Cut the baseboard to size (its
dimensions accommodate all the
batteries), clean it up with the
plane and sandpaper, and give it a
coat of shellac—always put a "Sun-
day dress" on your work; you've
no idea how it adds to your reputa-
tion as a radio man among those
to whom the technical details are

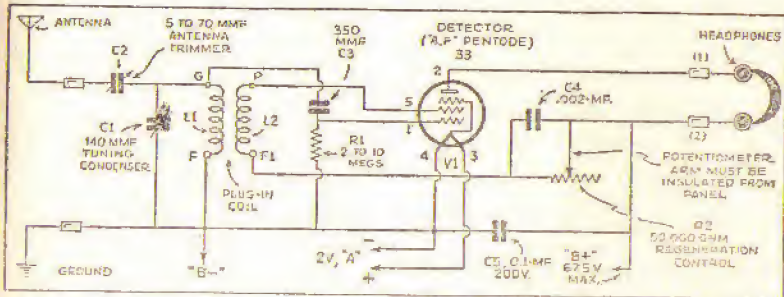


Fig. 1.—Complete Schematic Diagram of the All-Wave 1-Tube Receiver.

just so many long words!

Cut the aluminum panel to size
(if you didn't buy it that way)
with a wood saw—it won't hurt
the saw. Smooth the edges of the
panel with the plane. Next, lay
out and drill the three small holes
along the bottom for mounting;
also the two larger holes for the
condenser and potentiometer. If
you have a drill of the proper size
for these last mentioned holes use
it; otherwise, use the largest you
have and enlarge the holes with
the rat-tail file. Don't scratch the
panel all up while working on it as
that spoils the whole appearance
of the set. Always put a piece of
light cardboard between the panel
and table top when you hold it
down for drilling; and clean away
all chips from underneath.

Now fasten the panel to the front
of the baseboard and mount all the
parts.

A word regarding the antenna
system may not be amiss here,
since the builder of this set is sup-
posed to be an absolute beginner.
For best short-wave results the an-
tenna should be as high as possi-

ble and strung clear of everything
else; particularly, it should be kept
away from trees and be well in-
sulated. Two 2 or 3 in., high-grade
insulators at each end will give
excellent results. The best all
around wire for antenna purposes
is No. 14 solid enamel, about 50
ft. long. The aerial should be pulled
taut so that it cannot swing in the
wind and thus cause fading.
Springs are sold to be placed at
the end of aeriels for this purpose
and their use is advisable.

The lead-in can be made of No.
14 rubber-covered wire securely
soldered to the aerial at one end;
form a loop so as to allow the
aerial to move slightly without
eventually causing a break at this
joint. Stand-off insulators, holding
the wire several inches from the
building, should be used at inter-
vals along the length of the lead-
in. A lightning arrestor on the
outside of the building and going
to an outside ground is advisable,
particularly in rural regions. The
lead-in is carried into the house
through a porcelain tube which is
mounted in the window frame.

Slant the tube upward so that it will shed water. Don't under any circumstances, use one of those flat contraptions that is supposed to go under the window.

Inside the house, the set should be grounded with a wire, as short as possible, to the cold water piping. If convenient, this connection should be made on the street side of the water-meter as they sometimes have fiber bushings in them which break the electrical continuity of the pipe. If this is so in your case and you cannot conveniently run the line direct, at least "jump" the meter with a wire securely fastened to each side.

In country districts without piped

water an excellent ground can be made to the pump frame, or to one or more pipes driven 5 to 10 ft. into the ground. This may all seem very elaborate, but remember that the finest set made will operate better on an antenna system as described and it will surely operate our little set better. Furthermore, every point noted is important even on broadcast sets and becomes more and more so as the frequency is increased (wavelength reduced).

In locations particularly "tough" for reception it may be necessary to experiment with the direction of the aerial as this sometimes makes an appreciable difference.

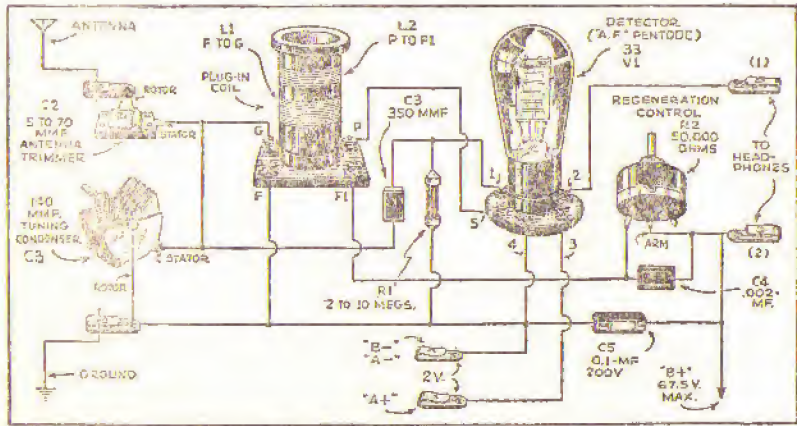


Fig. 2.—Pictorial Layout of the All-Wave 1-Tube Receiver. Beginners who are as yet not familiar with schematic diagrams will find this pictorial very helpful. The placement of parts is not critical, but it is important to have the shortest possible connections between the component parts.

The other point within our control, that of tuning, is primarily a question of patience. The most sensitive point for any regenerative receiver is just at the point of circuit oscillation. Turning the tuning dial and oscillation control together, meanwhile checking for the presence of oscillation by the method explained before will give you an approximate idea of just how the two line-up on any given coil. The procedure is to keep the set adjusted just inside the oscillation point and to turn the tuning dial very slowly until you hear a whistle; then, tune for the silent point between two whistles and "juggle" the oscillation control until you bring in the station. For broadcast and phone stations, this will be just outside the oscillation point; and for code stations, just inside. The main points to remember are: slow tuning; and, careful adjustment of the oscillation control.

Trouble Shooting

The set is so simple in design that trouble is not likely to occur; the foremost possibility, however, is lack of circuit oscillation. If the circuit will not oscillate, the first thing to do is to reverse the connections to P and F on the coil socket. The grid leak, R1, is also a factor in producing oscillation. Values from 1 to 10 megs. may be tried in this position. It may be necessary, particularly in the smallest coil, to add a turn or two to the tickler (the coil between the P and F socket terminals). Since the tube must be a good one—a poor tube will not oscillate—before going into the business of adding

turns it might be well to try another tube.

And while on the subject of tubes, heed the warning that the 2 V. series of tubes are very delicate and must be handled with extreme care. They will not stand an overload on the filaments—if this occurs, either from too much plate current or too much filament voltage—the emission from the filament is destroyed and the tube is rendered useless. In this particular circuit do not put more than 67½ V. of "B" battery in use (less, if possible).

Coil Data

It is advised that the beginner purchase a set of coils already wound, but if desired he may wind coils to the data given in Fig. 3. The coils are all wound on standard short-wave plug-in forms 1¼ ins. diameter x 2½ ins. long, four prong. The tuned winding is connected between the grid prong and one filament prong and the tickler between the plate and the other filament.

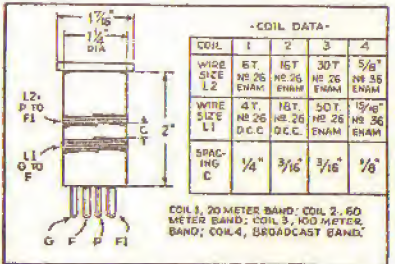
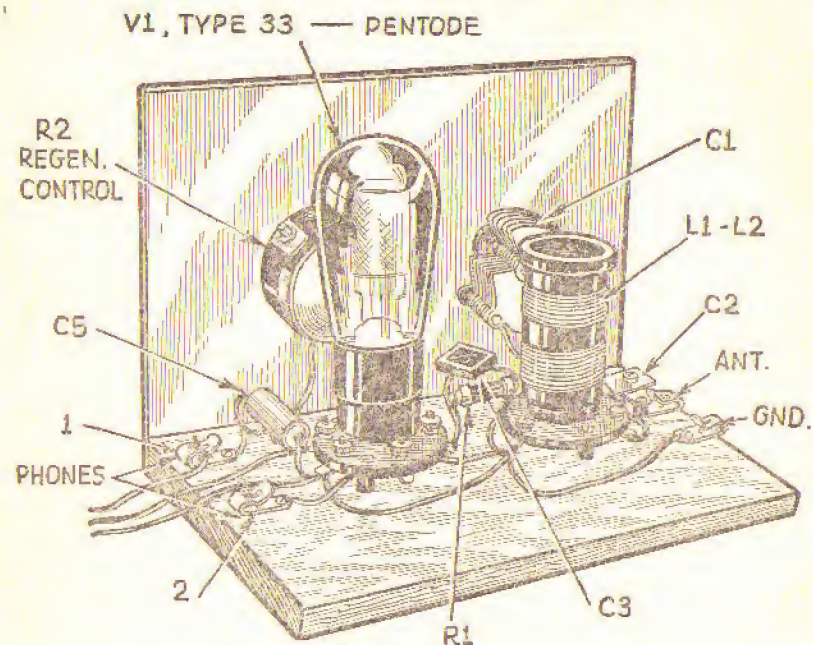


Fig. 3.—The Broadcast Coil is wound with no space between the turns and hence the turns are measured rather than counted.



List of Parts

One tuning condenser, 140 mmf., C1;
 One 5 to 70 mmf. antenna compensating condenser, C2;
 One 350 mmf. mica grid condenser, C3;
 One .002-mf. mica condenser, C4;
 One .1-mf. non-inductive paper condenser, 200 V., C5;
 One 2 meg. grid leak, R1;
 One 50,000 ohm wire-wound potentiometer, RE;
 One 4-prong socket for coils L1-L2;

One 5-prong spring mounted socket for the tube;
 Four spring binding posts;
 One wood baseboard, $8\frac{1}{4} \times 9 \times \frac{5}{8}$ in.;
 One aluminum panel, $8\frac{1}{4} \times 6 \times \frac{1}{16}$ in.;
 One type 33 tube, V1;
 One pair of sensitive headphones;
 One roll of push-back hook-up wire;
 Three $22\frac{1}{2}$ V. small "B" batteries;
 One 2 V. storage cell;
 Small screws;
 Four Fahnestock clips;
 One vernier dial.